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INTERNATIONAL RADIO REGULATIONS

Preparation for General World Administrative Radio Conference of International Telecommunication Union

FEDERAL COMMUNICATIONS COMMISSION

[Docket No. 20271; FCC 77-285]

INTERNATIONAL RADIO REGULATIONS

Preparation for General World Administrative Radio Conference of International Telecommunication Union; Fourth Notice of Inquiry

Adopted: April 27, 1977.

Released: May 17, 1977.

In the matter of an inquiry relative to preparation for a General World Administrative Radio Conference of the International Telecommunication Union to consider revision of the international Radio Regulations, Docket No. 20271.

1. On November 24, 1976, the Commission adopted a Third Notice of Inquiry in the above entitled matter (FCC 76-1099, No. 43086). It was released on December 6, 1976, and appeared in the FEDERAL REGISTER on December 13, 1976 (41 FR 54309). The period for comments and reply comments has passed.

2. The purpose of the Third Notice of Inquiry was to solicit comments on a proposed International Frequency Allocations Table (Article 5) see 42 FR 11258, February 28, 1977. The comments and reply comments received on the Third Notice of Inquiry are being considered by the Commission and will be dealt with later. In the Fourth Notice of Inquiry, we shall discuss the topics of the small antenna earth stations, several technical regulations, and the emission designator, thus reducing the number of subjects to be considered in the Fifth Notice of Inquiry. This will expedite our preparation for the General World Administrative Radio Conference (GWARC).

SMALL ANTENNA EARTH STATIONS

3. In the first Notice of Inquiry issued in this docket we solicited "comments or recommendations concerning changes or revisions to the international Radio Regulations which the public believes should be considered by the Commission in developing pertinent U.S. positions". One of the topics which arose in response to that Notice was the use of small diameter earth station antennas.[1] Space systems utilizing these stations can provide communications services which cannot be economically or conveniently provided by terrestrial systems, and already a number of communications systems using the small antennas have been authorized. For example, the Commission has authorized the use of several 4.5 meter antennas for domestic satellite communications to offshore oil drilling platforms, the use of 69 earth stations with 4.5 meter antennas to provide communications to "bush" communities of Alaska, as well as several smaller antennas on a developmental basis. Recently, we issued a Declaratory Ruling[2] dealing with the use of small antennas with domestic satellites, and have authorized several small antennas pursuant to that decision for the reception of program material distributed by domestic satellites.

4. In addition to the use of small antennas in the Fixed-Satellite Service, other space radiocommunications services are also involved which are substantially different and may require totally different criteria than discussed herein. For instance, small antennas are used in the shipboard terminals served by the MARISAT system providing communications services in the Maritime-Mobile Satellite Service, and are intended to be used in the AEROSAT program to conduct experimental communications in the Aeronautical-Mobile Satellite Service. The United States government is also expected to make frequent use of small diameter antennas. A number of small antennas have been used, and are being used, in the Applications Technology Satellite (ATS-6) and the Communications Technology Satellite (CTS) experimental programs. The U.S. Government Communications Satellite System (USG CSS)[3] utilizes small antenna earth stations and the use of small antennas is included in the proposed Disaster Warning Satellite[4] program.

5. It is apparent that there will be a steady growth in potential uses of small antenna earth stations in all of the space services; however, uncontrolled use of these terminals could have a significant adverse impact on the utilization of the limited spectrum and orbit resource of the geostationary satellite orbit. The long term resource requirements imposed by expected use of small earth terminals and the effects of that use should be treated in the U.S. preparation for the 1979 GWARC. Accordingly, in the Second Notice of Inquiry issued in this docket we solicited comments and supporting technical material with respect to the use of small earth terminals on the following points:

(a) Identification of the communication services and operational characteristics which entail use of small diameter earth station antennas;

(b) Estimates of the volume (in terms of voice channels and/or bit rate, and required rf bandwidth) of the communications services to be provided by means of small earth terminals, and the estimated number of small earth terminals to be used in the provision of such services, including the geographic distribution of the small terminals;

(c) Identification of the typical baseline technical characteristics of the satellite network serving small earth terminals; and

(d) Identification of the preferred frequency bands to be utilized to serve small earth terminals.

Various parties submitted comments, and they have all been considered. Because of space limitations they are not summarized herein; however, they will be noted where appropriate in the following discussion.

6. The diameter of an earth station antenna could affect the interference levels between satellite networks, as well as between terrestrial and earth stations in bands shared by both space and terrestrial radio services. The Carrier to thermal Noise (C/N) ratio obtained at an earth station could also be dependent on the earth station antenna diameter, although the imposition of a Power Flux Density (PFD) limit in certain bands tends to set a limit on the minimum usable size of the earth station antenna. When the diameter of an earth station antenna is reduced, the main beam gain is reduced; however, the sidelobe level of most antennas generally remains unaltered, or increases, with this reduction. It follows that the difference between the main beam gain and the sidelobe level, called the discrimination, generally decreases with the diameter of the antenna. When every other parameter of a receive earth station antenna remains unaltered,[5] a reduction of the antenna diameter generally increases the interference introduced into it from adjacent satellites and decreases its Carrier to Interference (C/I) ratio. Similarly, as a transmitting earth station antenna diameter is reduced, the antenna gain is reduced; this generally results in a requirement for more transmit power to satisfy the link budget. Increased transmitter power results in more interference power into adjacent satellite and adjacent terrestrial systems.

7. The comments and reply comments concerning this question raised in the Second Notice of Inquiry have generally focused on the use of small antennas in the Fixed-Satellite Service, with emphasis on the 4 and 6 GHz bands used by domestic satellite systems. A number of technical approaches were suggested, such as restrictions on off-axis EIRP density or the imposition of a minimum Gain to noise Temperature (G/T) ratio. Some parties also suggested that exclusive allocations be made for Small Antenna Earth Stations (SAES). That such questions need be addressed is apparent from the increased use of small antennas which is generally expected in the future. For example, COMSAT General estimates requirements of 1600 MHz, 800 MHz and 950 MHz for use by small antenna earth stations in providing data, video and facsimile, and voice communications (assuming 60 kHz channels), respectively, by the year 2000 in the Fixed-Satellite Service alone. While our Declaratory Ruling and Order referenced above addressed the use of small an-

[1] For convenience, an earth station antenna can be considered to be "small" if its gain is less than or equal to the gain of a parabolic antenna whose diameter is less than ninety times the operating wavelength (4.5 m at 6 GHz).

[2] *Declaratory Ruling and Order* (FCC 76-1169) adopted December 15, 1976 in RM-2614 and RM-2725.

[3] Characteristics of the United States Government Communications Satellite System, Phase II, US CCIR SG 8C/234, 1976.

[4] Disaster Warning Satellite Study update, NASA, TMX-73407, Lewis Research Center, Cleveland, Ohio, May 1976.

[5] In practice, the communications services provided by means of small antenna earth stations tend to differ substantially in quantity and quality from those provided by meansmeans of larger antennas.

tennas with our present domestic satellites in a manner that insures reasonably small orbital separations between satellites, consideration is appropriate to the question of how small antennas could be employed on a worldwide basis in a manner that insures efficient orbit and spectrum use. While this question is of importance not only in the Fixed-Satellite Service, but also in the other space services where operational requirements could lead to the use of antennas that are small enough to be carried by hand, specific criteria for them are not addressed in this Inquiry. These issues, except as noted above, and suggested approaches to resolution will be discussed in the following paragraphs.

8. The frequency bands 2500–2535 and 2655–2690 MHz, according to AT&T, "* * * have already been allocated for support services which are usually considered to be of the small earth terminal variety." AT&T believes that the frequency bands 6625–7125 MHz and 11.7–12.2 GHz are both suitable for accommodating SAES; the latter has no sharing problems with the fixed service in the U.S. It also believes that the frequency band 12.5–12.75 GHz is suitable for SAES use because the smaller number of radio relay systems in this band makes the sharing problem less critical than in the 6 and 4 GHz bands. Collins Radio, in its reply comments, supported the contentions of AT&T. Transcommunications suggested that a clear channel of 40 MHz in the 6/4 GHz bands should be established for SAES operations. EXXON suggested that the SAES could be shifted at a later date from the 6/4 GHz bands to other frequency bands or that they could be required to use more sophisticated equipment. In addition, AT&T stated that the frequency band 14.0–14.5 GHz is currently free of sharing between the space and terrestrial services. American Satellite Corporation also expressed the need for exclusive allocations to SAES below 10 GHz. However, other respondents did not agree to this approach. Both Communications Satellite Corporation (COMSAT) and COMSAT General Corporation (COMSAT General) opposed allocation of exclusive frequency bands to SAES.

9. The frequency bands 2500–2535 and 2655–2690 MHz have a comparatively small 35 MHz bandwidth and as such could be less attractive. In the United States, this band is shared co-equally with the Instructional Television Fixed Service (ITFS). The sharing situation between an ITFS omnidirectional transmitter and an earth station is very critical. To this time, no common carrier has decided to put a transponder in this band. Considering this, these frequency bands may not offer an attractive choice for SAES use in the U.S.

10. Contrary to the assertions of AT&T, the frequency band 6625–7125 MHz is heavily used, although it may be less so than the 3700–4200 MHz band. In the U.S., the 6625–7125 MHz band is allocated to private microwave and television pickup whereas the 3700–4200 MHz band is allocated to common carrier point-to-point microwave. In order to satisfy the requirements stated by the advisory Fixed-Satellite Service Working Group, the frequency band 6625–6925 * MHz has been proposed for the Fixed-Satellite (Earth-to-space) service. The frequency band 6625–7125 MHz is presently allocated to the Fixed-Satellite Service (Space-to-earth) in Brazil, United States and Canada on a secondary basis by footnote 392AA [*A]. In order to provide protection to SAES, the band 6925–7125 MHz would have to be allocated internationally on a primary basis.

11. In Region 2, the frequency band 11.7–12.2 GHz is allocated on a primary basis to both the Fixed-Satellite and Broadcasting-Satellite Services, as well as to terrestrial services, on a co-equal primary basis. Within the United States, however, this band is allocated on a primary basis only to the two space services. For individual reception, relatively small diameter antenna earth stations are proposed to be used with high EIRP satellites. COMSAT General, in its comments to the Second Notice of Inquiry, stated that "* * * small earth terminals employing SCPC transmissions in a fixed service satellite system would be subject to interference from higher power broadcasting satellite service. Nevertheless, for certain types of small user applications, use of the 12/14 GHz bands at this time is the only feasible alternative * * * However, the relatively large EIRP difference, anticipated between broadcasting and fixed satellites operating in this band may restrict the utility of this band for such SAES applications. Further study is needed to assess the impact of high EIRP television transmissions in the Broadcasting-Satellite Service on the type of SCPC operations contemplated for SAES in this band.

12. If frequency bands are to be allocated exclusively to SAES, as proposed by AT&T, then the frequency band 11.7–12.2 GHz could be one choice, with 6925–7125 MHz (after primary allocation), 2500–2535 MHz and 2565–2690 MHz the other, but perhaps less attractive in terms of the available bandwidth choices. The 2.5 GHz band is reasonably developed and the space attenuation is independent of weather conditions. The 12 GHz band is currently being developed and requires a fade margin for rain/snow attenuation. There is currently no satellite service in the 6925–7125 MHz band; however, it appears there would be little difficulty in borrowing the available technology from the adjacent bands.

Technical Approaches

13. A number of technical approaches were suggested by the parties to specify limitations on technical design or operating parameters of SAES in order to set bounds on the impact of such facilities on spectrum and orbit utilization. While the proposals discussed below are prompted by SAES, they would be presumably applied to all types of earth station facilities.

Interference Level

14. Both COMSAT and COMSAT General stated that the single entry 400 pWpO interference level of CCIR Recommendation 466 (Rev. 74) should be the overriding sharing criterion. According to COMSAT General the 400 pWpO level of baseband interference should be met by an immediate adjacent satellite at an orbital separation of 4°. COMSAT has recently proposed that the amount of allowable interference specified by CCIR Recommendation 466 should be subject to a "scaling law" and should be a function of the ratio of the antenna diameter to the operating wavelength of the antenna. Basically, COMSAT proposes that the permissible intersatellite network interference for larger orbital spacings should be less than that for closer orbital spacings.

15. COMSAT General assumed an acceptable level of interference for digital transmission to be a degradation in the carrier to thermal noise (C/N) ratio of 0.2 dB; COMSAT pointed out that interference criteria for digital systems should be developed. COMSAT believes that a permissible change in the operating Bit Error Rate (BER) should be established and adopted by the 1979 GWARC.

16. The interference into an analog signal has been calculated using the convolution method.[7] This method has been extended [8] to calculate the interference caused by Single Channel Per Carrier (SCPC) channels used by a number of small antenna earth stations. These SCPC channels generally have a channel spacing of between 60 and 30 kHz, depending on the type of modulation employed and service application. While studies conducted to date have indicated an apparent feasibility of implementing such types of SCPC operations with 4 degree separations between current domestic satellites in the 4 and 6 GHz bands under certain limited conditions, such use has not yet been demonstrated in the general case.

17. AT&T has also expressed concern that a proliferation of SAES in the 4 and 6 GHz bands might impair the development and expansion of microwave relay systems in these bands, particularly since the present sharing criteria may not accurately reflect the aggregate interference over the entire length of a transcontinental system from a larger number of earth stations than the two or four presently assumed. Other parties take issue with AT&T's position, pointing to

* It is noted that 6875–6925 MHz is part of the proposed band which continues to be shared with terrestrial fixed services.

[*A] The Fixed-Satellite Service is a primary service in this band within the United States. However, changes in this allocation are presently under consideration; see Third Notice of Inquiry in this Docket.

[7] B. A. Pontano, J. C. Fuenzalida and N. K. M. Chitre, "Interference into angle modulated systems carrying multi-channel telephone signals," IEEE Transactions on Communications, Vol. COM–24, No. 6, pp. 715–726, June 1973.

[8] A. Das and George Sharp, "Convolution method of interference Calculation," FCC/OCE RS 75–04, April 1975.

the greater use that small antenna earth stations can make of natural or man-made shielding and the lower probability that such earth stations would be simultaneously transmitting on the same frequency. ASC stated that "* * * interference into a particular frequency slot in a terrestrial radio-relay system is more nearly proportional to the number of satellites being accessed * * *" However, none of these parties advanced specific proposals in this regard for our consideration.

UPLINK POWER LIMITATIONS

18. In order to limit the interference level produced by any SAES to an adjacent satellite, several respondents have proposed a numerical limit on the earth station radiation density. AT&T found "* * * considerable merit * * *" in the Commission suggested e.i.r.p. density criterion:

$$36-25 \log \theta \text{ dBW/4 kHz}, \quad 2.5<\theta<48^\circ.$$

AT&T suggested that this criterion should be applicable to any three-dimensional angle off the main beam axis. ASC, in its reply comments, agreed to the basic principle of a limit on the off-axis radiation density. EXXON and the Central Committee on the Telecommunications of the American Petroleum Institute endorsed the earth station e.i.r.p. density limit suggested by the Commission. Western Union also supported the concept of "* * * control of uplink power density * * *"

19. COMSAT derived and proposed a maximum PFD limit at the geostationary orbit from an earth station not to exceed

$$-115.5-25 \log \theta \text{ dBW/m}^2 \text{ in any 40 kHz band.}$$

It expressed the preference for radiation density expressed per 40 kHz because that is "* * * the narrowest RF carrier unit normally encountered in practice". The currently used bandwidth of 4 kHz was adopted because of the relationship to the "nominal" 4 kHz telephone channel and the convenience in measuring this value with available instrumentation; it has little relation to the bandwidth of the signal. A signal with a large spike may be able to pass the 40 kHz radiation density criterion, but may fail the 4 kHz density criterion. COMSAT recognized that, depending on the type of modulation, "* * * different carriers having the same maximum power flux density may produce substantially different interference levels * * *" COMSAT's proposal provides protection to satellites but not necessarily to terrestrial radio relay systems However, an off-axis three-dimensional e.i.r.p. density criteria could protect both satellites and radio relay systems.

20. COMSAT General calculated the level of the off-axis (4°) e.i.r.p. density that could be transmitted from an earth station without causing more than 400 pWpO of interference to an adjacent FM analog satellite system at an orbital separation of 4 degrees. Results of the calculations indicate a range of 10.4 to 27 dBW/4 kHz of permissible off-axis radiation depending on the transmission systems involved. COMSAT General concluded that it would not be possible to establish a single off-axis e.i.r.p. density limit, although it could be possible to specify a range of off-axis e.i.r.p. density for different transmission parameters. However, COMSAT General believes that the specifications of large sets of e.i.r.p. densities may not be practicable.

G/T RATIO

21. The ratio of the Gain of the antenna to the noise Temperature of the receiving system (G/T) is a figure of merit for an earth station. ASC stated that "The capacity, in number of circuits, of a transponder increases as the earth station G/T increases. This is because, in order to provide adequate transmission quality, satellite downlink power can be traded off against the earth station G/T. Since the downlink power is limited, more must be used to compensate for the lower G/T and lower gain of a small diameter antenna. This higher allocation of power thereby lowers the circuit capacity of a transponder. Thus transponder capacity varies directly with earth station G/T, up to a maximum capacity determined by the transponder bandwidth and earth station modulation techniques." COMSAT, EXXON, Collins Radio Group, Joint Council on Educational Telecommunication (JCET) and the Central Committee on the Telecommunications of the American Petroleum Institute opposed the establishment of any G/T criteria. AT&T suggested that a minimum value of G/T of 20 dB at 4 GHz is insufficient and proposed a minimum value of 30 dB.

ORTHOGONAL POLARIZATION

22. COMSAT believes that the use of polarization discrimination as a means to increase single-satellite capacity is economically and operationally vastly superior to its use in reducing interference between systems. COMSAT believes that the adoption of standards for polarization discrimination would not be desirable. Western Union submitted that, "* * * certain additional advantages accrue to future satellite systems which reuse the frequency spectrum with orthogonal polarization, it is also recognized that the mode of operation increases the cost of small diameter antenna earth stations * * *" Home Box Office (HBO) challenged the "cost penalty" statement of Western Union. HBO stated that Western Union had not offered any data to support the claim that a cost penalty is incurred by the use of small antenna earth stations in conjunction with cross-polarized satellite systems. JCET endorsed the adoption of cross-polarization standards.

SIDELOBE RADIATION

23. A SAES has generally smaller discrimination. ASC, JCET and AT&T suggested sidelobe control of the SAES; and AT&T suggested the following three-dimensional sidelobe envelope in the 4 GHz band for SAES:

$$32-25 \log (\theta) \text{ dBi} \quad 1^\circ \leq \theta \leq 48^\circ$$
$$-10 \text{ dBi} \quad 48^\circ \leq \theta \leq 180^\circ$$

However, EXXON opposed any regulation of sidelobes, and the Central Committee on Telecommunications of the American Petroleum Institute suggested that the SAESs should have less stringent sidelobe control. The Corporation for Public Broadcasting (CPB) is developing SAESs with smaller sidelobe levels. The paraboloidal reflector, off-set fed with a corrugated conical horn, has been demonstrated to be capable of providing radiation patterns with extraordinarily low radiation levels in the far-out and back-lobe regions. Levels more than 75 dB below the main beam maximum have been attained outside the mainbeam region—and beyond the first few sidelobes—for an antenna having a half-power beamwidth of approximately 1.7°.[9] It is likely that development of low-cost, low sidelobe antennas would reduce the barriers to SAES usage.

DISCUSSION

24. As noted in the Second Notice of Inquiry, the purpose of requesting comments on the use of small antenna earth stations was to seek suggestions from interested parties on how to insure efficient utilization of the orbit on an international basis. Our focus on small antenna reflects the potentially larger impact of such facilities on required satellite separations if no additional steps are taken to control their impact. As noted above, we have recently issued a Declaratory Ruling setting forth our approach to licensing small antenna earth stations with present domestic satellites in the 4 and 6 GHz bands in a manner that preserves orbital separations of 4 degrees required for standard size antennas with diameters of 10 meters or more. However, the approach taken in that decision was more of an administrative one in defining the types of technical showings and analyses required in applications submitted for authority to construct and operate small antenna earth stations, rather than the imposition of specific technical standards on the design and operation of such facilities. While such a flexible approach is feasible on a domestic basis, it is not evident that an analogous type of approach is feasible on an international basis. This is because the current coordination and notification procedures set forth in Article 9A of the international Radio Regulations are directed to avoiding unacceptable levels of interference to existing satellite networks, not to insuring reasonably small satellite separations.

25. With respect to the proposals of several parties that exclusive allocations or sub-allocations be reserved for com-

[9] H. Paris Coleman, R. M. Brown and B. D. Wright, "Paraboloidal reflector offset fed with a corrugated conical horn", pp. 817–819, IEEE Trans. on Antennas and Propagation, November 1975.

mon carrier SAES operations, we are not convinced that this would be a satisfactory approach. In particular, there is a wide range of communications requirements that can be satisfied with SAES in a manner that would not require large orbital separations between satellites. Specific requirements have not been identified for SAES which cannot be satisfied with careful coordination between satellites to preserve reasonably small satellite separations. Absent such requirements, it appears preferable to avoid distinctions in the international Radio Regulations with respect to the use of certain frequency bands that are based only on antenna size.

26. Accordingly, parties advocating exclusive allocations or sub-allocations for SAES operations should focus their comments on the following points:

(a) What types of communications requirements require transmissions from SAES that are incompatible, even with careful frequency coordination, with reasonably small (e.g., less than 4 degrees) satellite spacings achievable with larger antennas;

(b) Given such requirements, would the present allocations in the vicinity of 2.5 GHz have sufficient bandwidth to support economically feasible systems, or would a wider bandwidth, e.g., 6625–6925 MHz, be required; in the latter event, where would the corresponding downlink allocation be located; and

(c) In the event such allocations were limited to the types of uses of SAES identified in (a) above, what orbital separations would be possible in such bands.

27. The technical approaches suggested by several of the parties appear to have a greater degree of effectiveness. However, it is still necessary to further examine these suggestions to insure that any such restrictions do not inadvertently preclude types of services that may be provided by SAES after necessary coordination is effected that retains reasonably small satellite separations. Of these suggestions, EIRP density limits and/or antenna sidelobe standards appear to have the greatest support. However, as pointed out by COMSAT General, a wide range of power densities can be expected in actual practice. Any proposed limit would therefore only preclude the worst case type of situations with additional frequency coordination required to accommodate other cases and still maintain small spacings. While a power limit as a function of off-axis angle would be sufficient in the case of transmitting earth stations, some limit on receiving antenna characteristics would appear necessary under such an approach to maintain orbital separations required to protect receiving stations to reasonable values. However, restrictions on minimum G/T ratios were not widely supported and do not in themselves appear to provide sufficient assurance that reasonably small orbital separations will result.

28. Accordingly, it appears desirable to obtain additional comments with respect to proposals to place restrictions on technical characteristics of earth station facilities. Specifically, the following points should be addressed:

(a) Would a power limitation of the magnitude discussed in paragraphs 18 and 19 above preclude types of services that could otherwise be accommodated with reasonably small satellite separations through careful frequency coordination;

(b) What should be the specific numerical value and the reference bandwidth for the specification of e.i.r.p. densities;

(c) Is it technically and economically feasible to achieve, in practice, the following sidelobe level:

$$\text{Gain, dB} = 30 - 25 \log_{10} \theta, \quad 2.5 < \theta < 48^\circ$$
$$-12, \quad 48^\circ < \theta \leq 180^\circ$$

where θ = angle off the main beam axis.

(d) What interference criteria should be used for digital systems? What should be permissible bit error rate?

(e) Is the use of cross-polarization more effective in increasing the capacity of an individual satellite by frequency re-use or in reducing separation between satellites? Is the use of orthogonal polarization economically and technically feasible for reducing interference related to SAES systems? What values of cross-polarization, if any, should be specified?

(f) For what bands should such standards be specified, and how would such values change with the frequency band to which they are applicable?

29. While we recognize the importance of interference criteria establishing required satellite spacings, it has not been considered appropriate to specify such values in the international Radio Regulations themselves. Rather, such criteria have more appropriately been set forth in relevant CCIR Reports and Recommendations for the guidance of administrations in effecting coordination under Articles 9 and 9A. However, to the extent that more current criteria are available for the purpose of determining when coordination is required through Appendices 28 and 29, consideration is appropriate to including such revised criteria there. Comments in this regard are requested.

30. Finally, it is noted that the majority of comments have focused only on the 4 and 6 GHz bands used by present fixed satellites. It must be emphasized, however, that the 1979 GWARC will be concerned with all frequency bands and all space radiocommunications services. However, the considerations discussed above are primarily applicable to the Fixed- and the Broadcasting-Satellite Services, whereas the criteria for other services could be substantially different.

Technical Regulations

31. The Commission is reviewing the technical provisions of the Radio Regulations.

32. The Commission is recommending changes in Article 7 and in Appendices 3 and 4 as discussed in Appendix A. In the regulations 470VC through VE, the station keeping of space stations is proposed to be ±0.1 degree which will provide better orbit-spectrum utilization. In the regulation 470 VF, the spacecraft antenna pointing error is proposed to be 0.1 degree providing reduced inter-satellite system interference and providing reduced unwanted signals in the adjacent territory of another Administration. Similar provisions were adopted in the 1977 Broadcasting-Satellite World Administrative Radio Conference.

33. In the Third Notice of Inquiry we submitted three options for the expression of a frequency tolerance and asked for the public's opinion on which would be most appropriate in the international Radio Regulations. The first option expressed the tolerance as a percentage of carrier frequency (as in the present Radio Regulations); the second option applied an absolute tolerance to each frequency band; and the third applied a percentage tolerance related to the authorized or necessary bandwidth. The American Telephone and Telegraph Company and the COMSAT General Corporation commented on the options.

34. AT&T stated that "The first two options are equally preferable and the third is less desirable." It believes the first method is attractive because "* * * in equipment design the maximum possible frequency tolerance tends to be proportional to the absolute frequency" and also because "* * * the difficulty of maintaining a transmitter within a specified frequency range generally increases in proportion to carrier frequency"; however, AT&T states one drawback is that "* * * it may result in transmitters in higher bands being allowed to drift more than those in lower bands * * *". It believes that the second method "* * * relates directly to the ways in which equipment is operated and maintained * * * maintenance instructions ordinarily specify the requirements in absolute frequency * * *". AT&T opposes the adoption of the third method because "* * * narrowband users in a given bandwidth might be required to maintain a tighter tolerance than a wideband user in the same band" and that would constitute a double standard. AT&T noted that the fundamental problem in specifying tolerances is that prescribed tolerances are applied over too wide a range and recommended that tolerances be specified for each frequency band; in that case it would make little difference if the permissible tolerance were stated as an absolute number or as a percentage.

35. COMSAT General supported the second option because "* * * option (a) will result in either too tight specifications for low frequency bands, or loss of spectrum at high frequency bands, while option (c) on the other hand will result in various frequency tolerance specifications within the same frequency band, based upon the authorized or necessary bandwidth".

36. Paragraph 154 of the Third Notice of Inquiry presented three options for designating frequency tolerances for radio relay systems. The comments received indicated a "preference" for the second option, which would apply an

absolute tolerance to each frequency band in the Radio Regulations, and an opposition to the third option, which would apply a percentage tolerance relater to the authorized or necessary bandwidth. Since one of the two respondents stated the first two options are equally preferable, we have made proposals for modification to Radio Regulation Appendix 3 which uses both methods, dependent upon the specific characteristics of the radio services involved.

37. The revisions to Appendices 3 and 4 of the Radio Regulations are proposed herein for the purpose of obtaining comments. In many cases the frequency tolerances shown for the proposed revision of Appendix 3 are more stringent than are required by the FCC rules, or within the Government. The current tolerances required by the Radio Regulations are much too loose when compared with the current state of the art. Tighter tolerances would lead to improved spectrum utilization. The big question is how much tigther should these tolerances be. Comments, therefore, are sought on the technical rationale to depart from the tolerances shown. To accommodate expected improvements in spectrum utilization by certain services, it was deemed necessary to propose tighter tolerances than are required by the current Radio Regulations.

EMISSION DESIGNATORS

38. The designation of emissions is set forth in Article 2 of the Radio Regulations. This designation consists of the necessary bandwidth, the type of modulation of the main carrier, the type of transmission, and supplementary characteristics. Reference is made within the international Radio Regulations to specific emission designations in Articles 5, 7, 28, 28A, 29A, 32, 35, 36 and 39, as well as in numerous Appendices, and Resolutions. The designation of the emission is a very important and useful tool in the management of the radio spectrum, especially with regard to the evaluation of potential for and susceptibility to interference.

39. Recommendation 8 of the Administrative Radio Conference, Geneva, 1959, requested that the CCIR, in conjunction with the IFRB, study various methods of designating and classifying emissions. The method was to be one which would suffice over a long period, and which would enable all of the *essential* information of the emissions to be provided (emphasis added). The CCIR engaged this task and produced Recommendation 432 in earlier Plenary Assemblies. After a period of testing, the U.S. found Recommendation 432 to be unacceptable and made further recommendations which led to the adoption of Opinion 44 at the XIIIth Plenary of the CCIR. Opinion 44 calls for Administrations to conduct trials of the method of classifying and designating their emissions as described in the Annex to Opinion 44 with the ultimate object of enabling the next appropriate Administrative Radio Conference to consider the method for inclusion in the Radio Regulations.

40. Extensive trials of the new emission system were not conducted; however, various government agencies examined the new proposal to determine its impact on their operations. While comments generally indicated that the system described in Opinion 44 could be implemented, there was strong concern evinced over whether there was to be any benefit derived from the new system and what impact the new system would have on day-to-day operations. Opinion 44 was studied further by the U.S. in its CCIR activities and a new proposal to modify Opinion 44 was submitted to the May–June 1976 CCIR Interim Meetings. The U.S. proposal, along with those of several other administrations, resulted in a revised Opinion 44 being adopted by the interim meetings. The U.S. is now attempting to refine this system even further, looking towards its final adoption at the CCIR Final Meetings, thereby providing a sound basis for U.S. proposals in this area to the 1979 World Administrative Radio Conference. This refinement is a continuing process, as is the entire conference preparatory activity. Attached as Appendix B to this Notice of Inquiry is the latest version of the emission designator system being considered by the United States for possible eventual submission to the 1979 WARC. Comments are solicited regarding the merits, advantages and disadvantages of this new system as opposed to the current method, bearing in mind that the United States has been a leader in the revision of the emission designator system and that some modification to the system will be inevitable at the 1979 WARC.

41. All participants should keep in mind the importance of the 1979 WARC results. Based upon past experience, decisions reached at this conference can be expected to provide the basis for international radio regulation policy for most of the remainder of this century. It is of the utmost importance to develop U.S. proposals which effectively promote that combination of telecommunication uses which offers the maximum social and economic contribution to the national welfare and which also contain the flexibility necessary to accommodate important new applications of this dynamic technology as well as the unique requirements of our international partners in the ITU. It must be recognized that the U.S. proposals are for the GWARC and that the national implementation of the results of the GWARC will require extensive U.S. national consideration.

42. Comments on the use of small antenna earth stations relevant to the preparation for the 1979 GWARC are hereby sought from all interested United States individuals, parties, or groups of parties which may exist.

43. Pursuant to applicable procedures set forth in § 1.415 of the Commission's rules, interested persons may file comments on or before July 11, 1977, and reply comments on or before July 26, 1977. All relevant and timely comments and reply comments, along with any pertinent information which the Commission may have available, will be considered. When commenting, it should be borne in mind that this effort is directed toward international regulations and not domestic issues. The U.S. wants to achieve maximum flexibility in international regulatory proposals.

44. Although § 1.419 of the Commission's Rules required that an original and five copies of all statements, briefs or comments be filed in response to a Notice, the Commission's conference preparatory organization necessitates the filing of an original and nineteen copies. All responses received will be available for public inspection during regular business hours in the Commission's Public Reference Room at its Headquarters in Washington, D.C.

45. This Notice is issued pursuant to the authority set forth in section 4(i) of the Communications Act of 1934, as amended 47 U.S.C. 154 (i).

FEDERAL COMMUNICATIONS COMMISSION,
VINCENT J. MULLINS,
Secretary.

Appendix A

(Technical Regulations)

Spa2 Station Keeping of Space Stations[2]

470VB § 26. Space stations on geostationary satellites:
Spa2

MOD 470VC
Spa2 -shall have the capability of maintaining their positions within ~~±~~ 0.1 degree of the longitude and latitude of their nominal positions, but efforts should be made to achieve a capability of maintaining their positions at least within ~~±0.5~~ 0.05 degree of the longitude and latitude of their nominal positions;

MOD 470VD
Spa2 -shall maintain their positions within ±0.1 degree of longitude and latitude of their nominal positions irrespective of the cause of variation; but

NOC 470VE
Spa2 -need not comply with No. 470VD as long as the satellite network to which the space station belongs does not produce an unacceptable level of interference into any other satellite network whose space station complies with the limits given in No. 470VD.

Spa2 [2]In the case of space stations on geosynchronous satellites with orbits having an angle of inclination greater than 5 degrees the positional tolerance shall relate to the nodal point.

470VE.1
Spa2 [1]The level of unacceptable interference shall be fixed by agreement between the administrations concerned, using the relevant C.C.I.R. Recommendations as a guide.

Reason: In the interest of more efficient orbit-spectrum utilization, it is considered necessary to maintain a closer station-keeping tolerance of ±0.1 degree in longitude and latitude. This minimizes the loss in receiving antenna gain and aids in reducing the potential for interference.

Spa2 Pointing Accuracy of Antennae on Geostationary Satellites

MOD 470VF § 27. The pointing direction of maximum radiation of any earth-
Spa2 ward beam of antennae on geostationary satellites shall be capable of being maintained within:

~~1~~ 2% of the half power beamwidth relative to the nominal pointing direction, or

~~0.5~~ 0.1 degree relative to the nominal pointing direction, whichever is greater. This provision applies only when such a beam is intended for less than global coverage.

In the event that the beam is not rotationally symmetrical about the axis of maximum radiation, the tolerance in any plane containing this axis shall be related to the half power beamwidth in that plane.

This accuracy shall be maintained only if it is required to avoid unacceptable interference[2] to other systems.

470VF.1
Spa2 [2]The level of unacceptable interference shall be fixed by agreement between the administrations concerned, using the relevant C.C.I.R. Recommendations as a guide.

Reason: These modifications are proposed to minimize the spillover outside the intended coverage area and to take maximum advantage of frequency re-use when pencil beams are used. It is necessary to maintain the highest possible beam-pointing accuracy.

APPENDIX 3

Mar Mar2

Table of Frequency Tolerances*

(See Article 12)

1. Frequency tolerance is defined in Article 1 and is expressed in parts in 10^6 or, in some cases, in ~~hertz~~ Hz.

2. The power shown for the various categories of stations is the mean power as defined in Article 1.

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, ~~1964~~ 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1985 and to all transmitters after 1st January, ~~1966*~~ 1987
Band: 10 to 535 kHz		
1. Fixed Stations:		
- 10 to 50 kHz	1 000	~~1 000~~ 100
- 50 to 535 kHz	200	~~200~~ 50
2. Land Stations:		
a) Coast Stations:		
- power 200 W or less	500 l)	~~500~~ 20 Hz k)
- power above 200 W	200 l)	~~200~~ 20 Hz k)
b) Aeronautical Stations	100*	~~100*~~ 50
3. Mobile Stations:		
a) Ship Stations	1 000 k)	~~1 000~~ 20 Hz k)
b) Ship's Emergency Transmitters	5 000	~~5 000~~ 20 Hz

*~~1st January, 1970 in the case of all tolerances marked with an asterisk.~~

*Certain services may need tighter tolerances for technical and operational reasons.

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, ~~1964~~ 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1985 and to all transmitters after 1st January, ~~1966*~~ 1987
c) Survival Craft Stations	5 000	~~5 000~~ 20 Hz
d) Aircraft Stations	500	~~500~~ 50
4. Radiodetermination Stations	100*	100*
5. Broadcasting Stations	10 Hz	10 Hz
Band: 535 to 1 605 kHz Broadcasting Stations	10 Hz b)	10 Hz
Band: 1605 to 4 000 kHz		
1. Fixed Stations:		
- power 200 W or less	100	100
- power above 200 W	50	50
2. Land Stations		
- power 200 W or less	100h) l)	~~100~~ 50 h) l)
- power above 200 W	50h) l)	50 h) l)
3. Mobile Stations		
a) Ship Stations	200 i) k)	~~200~~ 20 Hz i) k)
b) Survival Craft Stations	300	~~300~~ 20 Hz
b A) Emergency Position-Indicating Radiobeacons	300	~~300~~ 20 Hz
c) Aircraft Stations	100 *	100 r)
d) Land Mobile Stations	200	~~200~~ 20 Hz

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, ~~1964~~ 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1985 and to all transmitters after 1st January, ~~1966*~~ 1987
	~~*1st January, 1970 in the case of all tolerances marked with an asterisk.~~	
4. Radiodetermination Stations:		
- power 200 W or less	100	~~100~~ 20
- power above 200 W	50	~~50~~ 10
5. Broadcasting Stations	20	~~20~~ 10 Hz
Band: 4 to 29.7 MHz		
1. Fixed Stations:		
- power 500 W or less	50	~~50~~ 30
- power above 500 W	15	~~15~~ 10
2. Land Stations:		
a) Coast Stations:		
- power 500 W or less	50 h) l)	~~50~~ 20 Hz k) l)
- power above 500 W and less than or equal to 5 kW	30*h) l)	~~30*~~ 20 Hz k) l)
- power above 5 kW	15 h) l)	~~15~~ 20 Hz k) l)
b) Aeronautical Stations:		
- power 500 W or less	100	100 r)
- power above 500 W	50	50 r)
c) Base Stations:		
- power 500 W or less	100	~~100~~ 30
- power above 500 W	50	~~50~~ 10
3. Mobile Stations:		
a) Ship Stations		
1) Class A1 emissions	50 p) q)	~~50~~ 20 Hz p) q)
2) Emissions other than A1	50 i) k)	~~50~~ 20 Hz i) k)

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, ~~1964~~ 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1985 and to all transmitters after 1st January, ~~1966*~~ 1987
	~~*1st January, 1970 in the case of all tolerances marked with an asterisk.~~	
- power 50 W or less	50 c) i) k)	~~50~~ c) i) k) 20 Hz
- power above 50 W	50 i) k)	~~50~~ i) k) 20 Hz
b) Survival Craft Stations	200	~~200~~ 20 Hz
c) Aircraft Stations	100*	100* r)
d) Land Mobile Stations	200	200 20 Hz
4. Broadcasting Stations	15	~~15~~ 2
Band: 29.7 to 100 MHz		
1. Fixed Stations:		
- power 200 W or less	50*	~~50*~~ 30
- power above 200 W	30	~~30~~ 10
2. Land Stations:		
- power 15 W or less	50	50
- power above 15 W	20	20
3. Mobile Stations:		
- power 5 W or less	100	~~100~~ 50
- power above 5 W	50	~~50~~ 20
4. Radiodetermination Stations	200	~~200~~ 50

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, ~~1964~~ 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1985 and to all transmitters after 1st January, ~~1966*~~ 1987
	*1st January, 1970 in the case of all tolerances marked with an asterisk.	
5. Broadcasting Stations (other than television):		
- power 50 W or less	50	~~50~~ 1000 Hz
- power above 50 W	20	20 1000 Hz
6. Broadcasting Stations (television sound and vision):		
- power 50 W or less	100	~~100~~ 2000 Hz
- power above 50 W	1000 Hz	~~1 000~~ 500 Hz
Band: 100 to 470 MHz		
1. Fixed Stations:		
- power 50 W or less	50*	~~50*~~ 20
- power above 50 W	20*	~~20*~~ 10
2. Land Stations:		
a) Coast Stations	20 n)	~~20 n)~~ 10
b) Aeronautical Stations	50	~~50~~ 20
c) Base Stations:		
- power 5 W or less	50	~~50~~ 30
- power above 5 W	20	20 10
3. Mobile Stations:		
a) Ship Stations and Survival Craft Stations:		
- in the band 156-174 MHz	20 n)	~~20 n)~~ 10
- outside the band 156-174 MHz	50 d) o)	50 ~~d)~~ o)

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, 1964 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1985 and to all transmitters after 1st January ~~1966*~~ 1987
	~~*1st January, 1970 in the case of all tolerances marked with an asterisk.~~	
b) Aircraft Stations	50	~~50~~ 30
c) Land Mobile Stations:		
- power 5 W or less	50	~~50~~ 30
- power above 5 W	20	20 10
4. Radiodetermination Stations	50*d) e)	~~50*~~ 20 d) e)
5. Broadcasting Stations (other than than television)	20	20 15
6. Broadcasting Stations (television sound and vision):		
- power 100 W or less	100	~~100~~ 50
- power above 100 W	1000 Hz	~~1 000~~ Hz 500 Hz
Band: 470 to 2 450 MHz		
1. Fixed Stations:		
- power 100 W or less	300 f)	~~300~~ 100 ~~f)~~
- power above 100 W	100 g)	~~100~~ 50 ~~g)~~
2. Land Stations	300	~~300~~ 100
3. Mobile Stations	300	~~300~~ 100
4. Radiodetermination Stations	500e)	~~500~~ 400 e)
5. Broadcasting Stations (other than television)	100	~~100~~ 50

Frequency Bands (lower limit exclusive, upper limit inclusive) and Categories of Stations	Tolerances applicable until 1st January, ~~1966*~~ 1987 to transmitters in use and to those to be installed before 1st January, ~~1966~~ 1985	Tolerances applicable to new transmitters installed after 1st January, ~~1966*~~ 1987
~~*1st January, 1970 in the case of all tolerances marked with an asterisk.~~		
6. Broadcasting Stations (television, sound and vision) in the band 470-960 MHz		
- power 100 W or less	100	~~100~~ 50
- power above 100 W	1000 Hz	~~1 000 Hz~~ 500 Hz
Band 2 450 to 10 500 MHz		
1. Fixed Stations:		
- power 100 W or less	300 f)	~~300~~ 30 f)
- power above 100 W	100 g)	100 10 g)
2. Land Stations	300	~~300~~ 30
3. Mobile Stations	300	~~300~~ 30
4. Radiodetermination Stations	2000 e)	~~2 000~~ 800 e)
5. Space Stations	5	3
Band: 10·5 to 40 GHz		
1. Fixed Stations	500	~~500~~ 50
2. Radiodetermination Stations	7 500 e)	~~7 500~~ 2500 e)
3. Space Stations	10	7

Notes referring to Table of Frequency Tolerances

a) SUP

b) In the area covered by the North American Regional Broadcasting Agreement (NARBA) the tolerance of 20 Hz may continue to be applied.

c) SUP

d) This tolerance is not applicable to survival craft stations operating on the frequency 243 MHz.

e) Where specific frequencies are not assigned to radar stations, the bandwidth occupied by the emissions of such stations shall be maintained wholly within the band allocated to the service and the indicated tolerance does not apply.

f) For transmitters using time division multiplex the tolerance of 300 may be increased to 500.

g) This tolerance applies only to such emissions for which the necessary bandwidth does not exceed 3 000 kHz; for larger bandwidth emissions a tolerance of 300 applies.

h) For coast station single sideband radiotelephone transmitters the tolerance is 20 Hz.

i) For ship station single sideband radiotelephone transmitters the tolerance is
1) in the band 1 605 – 4 000 kHz
100 Hz for transmitters in use or to be installed before 1 January 1982
50 Hz for transmitters installed after 1 January 1982.
2) in the band 4 000 – 23 000 kHz
100 Hz for transmitters in use or to be installed before 1 January 1978.
50 Hz for transmitters installed after 1 January 1978
(See also Appendix 17A).

j) SUP

k) For ship station transmitters used for direct printing telegraphy or for data transmissions, the tolerance is 40 Hz. This tolerance is applicable to equipment installed after 1 January 1976 and to all equipment after 1 January 1985. For equipment installed before 2 January 1976 the tolerance is 100 Hz (with a maximum deviation of 40 Hz for short periods of the order of 15 minutes).

l) For coast station transmitters used for direct printing telegraphy and for data transmission the tolerance is 15 Hz. This tolerance is applicable to equipment installed after 1 January 1976 and to all equipment after 1 January 1985. For equipment installed before 2 January 1976 the tolerance is 40 Hz.

m) SUP

n) For coast and ship station transmitters in the band 156 – 174 MHz put into service after 1 January 1973 a tolerance of 10 parts in 10^6 shall apply. This tolerance is applicable to all transmitters, including survival craft stations, after 1 January 1983.

o) For transmitters used by on-board communication stations a tolerance of 5 parts in 10^6 shall apply.

p) Applicable from 1 June 1977. However, in the A1 Morse working frequency bands a frequency tolerance of 200 parts in 10^6 may be applicable to existing transmitters after 1 June 1977, provided that the emissions are contained within the band in question.

q) In the A1 Morse calling frequency bands frequency tolerances of 40 parts in 10^6 in the bands between 4 and 23 MHz and of 30 parts in 10^6 in the 25 MHz band are recommended as far as possible.

r) For single sideband transmitters operating in the Aeronautical Mobile (R) Service, the tolerance is:

1) In the band 1605 - 4000 kHz
Aeronautical Stations 10 Hz
Airport Stations 20 Hz

2) In the band 4 - 29.7 MHz
Aeronautical Stations 10 Hz
Aircraft Stations 20 Hz

REASON: See reasons for Appendix 4.

AP4 1

APPENDIX 4

Table of Tolerances for the Levels of Spurious Emissions

(See Article 12)

1. The following table indicates the tolerances which shall apply to the mean power of any spurious emission supplied by a transmitter to the antenna transmission line.

2. ~~Furthermore, spurious~~ Spurious radiation from any part of the installation other than the antenna system, i.e., the antenna and its transmission line, shall not have an effect greater than would occur if this antenna system were supplied with the maximum permissible power at that spurious emission frequency.

~~3. These tolerances shall not, however, apply to ship's emergency transmitters or survival craft stations.~~

4. 3. For technical or operational reasons, specific services may demand tolerances tighter than those specified in the Table.

~~5. The final date by which all equipment shall meet the tolerances specified in Column B is 1st January, 1970. Nevertheless, all administrations recognise the urgent need to implement Column B tolerances for all equipment at the earliest possible dates and will endeavour to ensure that necessary changes are made to all transmitters under their jurisdiction well before this date and wherever possible by 1st January, 1966.~~

~~6. No tolerance is specified for transmitters operating on fundamental frequencies above 235 MHz. For these transmitters the levels of spurious emissions shall be as low as practicable.~~

Fundamental Frequency Band	The mean power of any spurious emission supplied to the antenna transmission line shall not exceed the values specified as tolerances in Columns A and B below	
	A Tolerances applicable until 1st January, ~~1970~~ 1982 to transmitters ~~now~~ in use and to those installed before 1st January, ~~1964~~ 1980	B Tolerances applicable to new transmitters installed after 1st January, ~~1964~~ 1980 and to all transmitters after 1st January, ~~1970~~ 1982
Below 30 MHz	40 decibels below the mean power of the fundamental without exceeding the power of ~~200~~ 50 milliwatts	~~40~~ 60 decibels below the mean power of the fundamental without exceeding the power of 50 ~~milliwatts~~ [1][2][3] microwatts
30 ~~MHz~~ to ~~235 MHz~~ and above for transmitters having mean power:		
— greater than over 25 watts	60 decibels below the mean power of the fundamental without exceeding 1 milliwatt[4]	60 decibels below the mean power of the fundamental without exceeding ~~1 milliwatt~~ 50 microwatts
— 25 watts or less	40 decibels below the mean power of the fundamental without exceeding 25 microwatts and without the necessity for reducing this value below 10 microwatts[4]	~~40~~ 60 decibels below the mean power of the fundamental without exceeding 25 microwatts ~~and with out the necessity for reducing this value below 10 microwatts~~[4]

[1] For transmitters of mean power exceeding 50 kilowatts and which operate below 30 MHz over a frequency range approaching an octave or more, a reduction below 50 ~~milliwatts~~ microwatts is not mandatory, but a minimum attenuation of 60 decibels shall be provided and every effort should be made to keep within the 50 ~~milliwatts~~ microwatts limit.

[2] For hand-portable equipment of mean power less than 5 watts which operates in the frequency band below 30 MHz, the attenuation shall be at least 30 decibels, but every effort should be made to attain ~~40~~ 60 decibels attenuation.

[3] For mobile transmitters which operate below 30 MHz any spurious emission shall be at least ~~40~~ 60 decibels below the fundamental without exceeding the value of ~~200~~ milliwatts, 50 microwatts but every effort should be made to keep within the 50 ~~milliwatts~~ microwatts limit whereever practicable.

[4] For frequency modulated maritime mobile radio-telephone equipment which operates above 30 MHz, the mean power of any spurious emission falling in any other international maritime mobile channel, due to products of modulation, shall not exceed a limit of 10 microwatts and the mean power of any other spurious emission on any discrete frequency within the international maritime mobile band shall not exceed a limit of 2.5 microwatts. Where, exceptionally, transmitters of mean power above 20 watts are employed, these limits may be increased in proportion to the mean power of the transmitter.

REASON: It is believed that these tables should be revised to achieve an improvement to spectrum utilization. A review of both government and non-government tolerances shows that the specific limits appearing in the tables are attainable. Comments, however, are invited as to the desirability of using the specific tolerances shown.

U. S. PROPOSED REVISION OF CCIR DRAFT RECOMMENDATION AB/1

As requested by I.F.R.B. Circular-letter No. 357, 15 July 1976, we have evaluated the provisional method of classifying and designating emissions as proposed by C.C.I.R. Draft Recommendation AB/1 and are submitting the following comments and recommendations.

In general, the method proposed in C.C.I.R. Draft Recommendation AB/1, provides a means to specify all essential information relating to an emission and we endorse the principle of including the essential information in three mandatory symbols. Our recommendations and comments represent changes which, it is felt, should simplify the application of the method without sacrificing essential content and effectiveness. Recommendations are summarized below and are included in the enclosure, which is a proposed revision to Draft Recommendation AB/1:

a. A simplified method of designating necessary bandwidth is proposed;

b. Information dealing with the nature of the multiplexing signal was shifted from the fifth symbol (optional) and inserted as part of the second symbol;

c. The use of optional symbols by administrations may be implemented only as part of the administration's internal data process. Optional symbols should not be listed in Article 2; and,

d. The letter N has been substituted for O in the list of symbols to avoid confusion as to whether it is the number zero or the letter O.

The method designating the necessary bandwidth of emissions proposed in Recommendation AB/1 appeared to be unnecessarily complicated considering the universality of use of emission designators and compelling reasons to keep the designator as simple to understand as possible, while retaining completeness, in order to accommodate those less technically advanced. Moreover, there is a measurable advantage to be able to understand the bandwidth at a glance without performing any conversions. Accordingly, the method proposed, following that used in the United States, employs a letter H,K,M, or G to designate Hz, kHz, MHz or GHz

respectively, and a numerical value, having a maximum of four characters, including a decimal point. It was considered that if there was a computer reason to designate bandwidth in the "scientific method" proposed in Recommendation AB/1, then the conversion from a direct reading bandwidth should be made by those inserting the data into the computer. The method proposed is currently satisfactorily used in computer-based frequency management data systems in the United States. Examples, with comparison to Recommendation AB/1 are given below.

Necessary bandwidth	Proposed herein	Recommendation AB/1
25 Hz	H25	0250
400 Hz	H400	4000
2.4 kHz	K2.4	2401
12.5 kHz	K12.5	1252
36 kHz	K36	3602
180 kHz	K180	1803
1.25 MHz	M1.25	1254
6.25 MHz	M6.25	6254
27 MHz	M27	2705
200 MHz	M200	2006
5.6 GHz	G5.6	5607

A change from Draft Recommendation AB/1 which we are proposing affects the fifth optional symbol. The information contained in that symbol has been inserted into the second symbol because it was felt that the nature of the multiplexing signal was essential and should be included in the 3 mandatory symbols to preserve the use of the minimum number of symbols. This is consistent with judgments expressed previously in Recommendation 432-1 and Opinion 44 of the CCIR. The information was readily accommodated in the second symbol by allowing that symbol to become either alphabetical or numerical. The scheme adopted and outlined in the enclosure designates a modulated single channel emission by a number. Unmodulated and multi-channel emissions are designated by letters. In this manner, it was possible to retain the familiar symbols of Article 2 of F1, F2, F3, A1, A2 and A3 for single channel frequency modulated and double sideband emissions.

It is felt that the fourth symbol (optional) was not clearly defined and created a certain amount of confusion as to its application because it contains more than one character that could apply equally to describe an element of the emission. Further, some of the information, such as that relating to protection ratios or privacy should not be part of an emission symbol, even though its use is considered optional.

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NOTICES

U. S. PROPOSED REVISION OF CCIR
DRAFT RECOMMENDATION AB/1

ANNEX

PART 1

PROVISIONAL METHOD FOR THE DESIGNATION OF EMISSIONS**

1. Emissions are designated according to their necessary bandwidth and their classification. Whenever the full designation of an emission is required, the classification for that emission shall be preceded by an indication of the necessary bandwidth.

SECTION I

NECESSARY BANDWIDTH

2. The necessary bandwidth shall be expressed by a maximum of five characters as follows:

The first character shall be a letter H, K, M, or G to designate Hz, kHz, MHz or GHz respectively. The letter shall be followed by a number composed of a maximum of three significant digits and a decimal point, if necessary. The number may not be less than 1.

Examples

Necessary Bandwidth		Symbol
25	Hz	H25
400	Hz	H400
2.4	kHz	K2.4
12.5	kHz	K12.5
36	kHz	K36
180	kHz	K180
1.25	MHz	M1.25
6.25	MHz	M6.25
27	MHz	M27
200	MHz	M200
5.6	GHz	G5.6

** For certain terms used in Part 1, see Part 2.

SECTION II

CLASSIFICATION

3. Emissions are classified and symbolized according to the following characteristics. Modulation used only for short periods for incidental purposes such as identification, calling, etc., should be ignored.

SECTION II.1

BASIC CHARACTERISTICS

4.1 First symbol - Nature of emission (see Sec. 5 below).

4.2 Second symbol - Nature of signal modulating the main carrier and nature of multiplexing (See Sec. 6 below).

4.3Third symbol - Type of transmission (see Sec. 7 below).

5. First symbol-Nature of emission

5.1 Emission of an unmodulated carrier ..... N

5.2 Emission in which the main carrier is predominantly amplitude-modulated. It may include cases where sub-carriers are angle-modulated.

5.2.1 Double-sideband ..... A

5.2.2 Single-sideband, full carrier ..... H

5.2.3 Single-sideband, reduced carrier ..... R

5.2.4 Single-sideband, suppressed carrier ..... J

5.2.5 Independent sideband ..... B

5.2.6 Vestigial sideband C

5.3 Emission in which the main carrier is angle modulated

5.3.1 Frequency modulation ..... F

5.3.2 Phase modulation ..... G

5.4 Emission of pulses (the carrier may, in addition, be frequency modulated)*

5.4.1 Unmodulated sequence of pulses ..... P

*Emissions, where the main carrier is directly modulated by a signal which has been coded into quantized form (e.g. pulse code modulation), should be designated under Secs. 5.2 or 5.3.

5.4.2 A sequence of pulses which are modulated:

5.4.2.1 in amplitude ..... K

5.4.2.2 in width/duration L

5.4.2.3 in position/phase ..... M

5.4.2.4 by combinations of the foregoing or other means ..... Q

5.5 Cases not covered above, in which an emission consists of the main carrier modulated, either simultaneously or in a pre-established sequence, in a combination of two or more of the following modes:

- amplitude, - angle, - pulse ..... W

5.6 Cases not otherwide covered X

6. Second symbol - Nature of signal modulating the main carrier and nature of multiplexing

6.1 No modulating signal ..... N

6.2 A single channel containing quantized information without the use of a modulating sub-carrier* 1

6.3 A single channel containing quantized information with the use of a modulating sub-carrier* 2

6.4 A single channel containing analogue information 3

6.5 Two or more channels containing quantized information, operating simultaneously or in a pre-established sequence, all of which modulate the sub-carriers in frequency or phase.

6.5.1 Frequency-division multiplex ..... A

6.5.2 Time-division multiplex ..... B

6.5.3 Frequency-division multiplex with one or more channels using time-division multiplex C

6.5.4 Type of multiplexing other than above ..... D

6.6 Two or more channels containing quantized information operating simultaneously or in a pre-established sequence.

6.6.1 Frequency-division multiplex ..... E

6.6.2 Time-division multiplex ..... F

6.6.3 Frequency-division multiplex with one or more channels using time-division multiplex ..... G

6.6.4 Type of multiplexing other than above ..... H

6.7 Two or more channels containing analogue information operating simultaneously or in a pre-established sequence.

6.7.1 Frequency-division multiplex ..... J

6.7.2 Time-division multiplex ..... K

6.7.3 Frequency-division multiplex with one or more channels using time-division multiplex L

6.7.4 Type of multiplexing other than above ..... M

6.8 Composite system transmitting simultaneously, or in a pre-established sequence, one or more channels containing quantized information, together with one or more channels containing analogue information.

6.8.1 Frequency-division multiplex ..... P

6.8.2 Time-division multiplex ..... Q

6.8.3 Frequency-division multiplex with one or more channels using time-division multiplex ..... R

6.8.4 Type of multiplexing other than above ..... S

6.9 Cases not otherwise covered X

*This excludes time-division multiplex.

9.

7. Third symbol - Type of transmission.

7.1	Unmodulated main carrier or pulses	N
7.2	Telegraphy - manual	A
7.3	Telegraphy - automatic	B
7.4	Facsimile	C
7.5	Data transmission, telemetry, telecommand	D
7.6	Telephony (including sound broadcasting)	E
7.7	Television (video)	F
7.8	Combination of telegraphy (automatic) and facsimile	G
7.9	Combination of telegraphy (automatic) and telephony	H
7.10	Combination of facsimile and telephony	J
7.11	Combination of telephony and television	K
7.12	Combination of the above not otherwise covered	L
7.13	Cases not otherwise covered	X

10.

SECTION II. 2

ADDITIONAL CHARACTERISTICS

8. If Administrations wish to describe for their internal needs further details of an emission, additional symbols fitting the present method of designating emissions may be used.

PART 2

THE MEANING OF CERTAIN TERMS AS USED IN THIS ANNEX

Main carrier — The wave that may be combined with a modulating signal in the last modulation stage of a radio transmitter.

Sub-carrier — A carrier which is employed in an intermediate modulating process and then applied as part of the signal modulating the main carrier.

Analogue signal — A signal that follows the variation of a physical phenomenon continuously with an infinite number of possible values.

Quantized signal — A signal that varies over a finite number of discrete values.

PART 3

EXAMPLES

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
I. No modulation			
A. Emission of a radio-frequency carrier with no modulation			
A.1 No quantized or analogue information channels (CW radar)	or (AO (PO	[illegible]	
B. Unmodulated pulse train	PO	P[illegible]	
C. Unmodulated pulse train using frequency-modulated carrier (chirp radar)	PO	P[illegible]	
II. A single channel containing quantized information without the use of a modulating sub-carrier			
A. Emission predominantly amplitude-modulated			
A.1 Double-sideband (on-off keying)			
A.1.1 telegraphy using code with elements of differing numbers and/or durations, aural reception (Morse)	A1	A1A	
A.1.2 telegraphy using code with elements of differing numbers and/or durations, automatic reception (Morse)	A1	A1B	
A.1.3 telemetry using code with elements of the same number and duration, without error-correction	A1	A1D	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
B. Emission angle-modulated			
B.1 Telegraphy using code with elements of differing numbers and/or durations, automatic reception (frequency-shift keying, Morse)	F1	F1B	
B.2 Telegraphy using code with elements of the same number and duration without error-correction (frequency-shift keying, teleprinter)	F1	F1B	
B.3 Telegraphy using code with elements of the same number and duration with error-correction (frequency-shift keying, teleprinter)	F1	F1B	
B.4 Facsimile, quantized (weather chart)	F4	F1C	
B.5 Data transmission in quantized form	F1	F1D	
C. Emission of pulses			
C.1 A sequence of pulses modulated in code (telemetry signals)	F1C	Q1D	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
III. A single channel using quantized information with the use of a modulating sub-carrier			
A. Emission predominantly amplitude-modulated			
A.1 Double sideband			
A.1.1 telegraphy using code with elements of differing numbers and/or durations for aural reception (Morse) (on-off keying of modulated carrier)	A2	A2A	
A.1.2 telegraphy using code with elements of differing numbers and/or durations for automatic reception (on-off keying of a modulating sub-carrier)	A2	A2B	
A.2 Single-sideband, full carrier			
A.2.1 modulation by a continuous tone (standard frequency emission)	A2H	H2X	
A.2.2 telegraphy using code with elements of the same number and duration without error-correction (sequential single frequency code selective calling signal, Appendix 20C of the Radio Regulations)	A2H	H2B	

Description	RR Art. 2 Symbol	Symbols proposed in this method §§ 5, 6, 7	
A.3 Single-sideband, suppressed carrier			
A.3.1 telegraphy using code with elements of differing numbers and/or durations for automatic reception (on-off keying of modulating sub-carrier)	A2J	J2B	
A.3.2 telegraphy using code with elements of the same number and duration with error-correction (narrow-band direct-printing telegraphy)	A2J	J2B	
B. Emission angle-modulated			
B.1 Frequency modulation			
B.1.1 telegraphy using code with elements of the same number and duration with error-correction (narrow-band direct-printing signal, frequency-shift keying of modulating sub-carrier)	F2	F2B	

Description	RR Art. 2 Symbol	Symbols proposed in this method §§ 5, 6, 7	
IV. A single channel containing analogue information			
A. Emission predominantly amplitude-modulated			
A.1 Double-sideband			
A.1.1 sound channel of broadcasting quality	A3	A3E	
A.1.2 telephone channel with privacy device	A3	A3E	
A.1.3 telephone channel without privacy device	A3	A3E	
A.1.4 facsimile, analogue	A4	A3C	
A.2 Single-sideband, full carrier			
A.2.1 sound channel of broadcasting quality	A3H	H3E	
A.2.2 telephone channel of good commercial quality with privacy device	A3H	H3E	
A.3 Single-sideband, reduced carrier			
A.3.1 sound channel of broadcasting quality	A3A	R3E	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
A.4 Single-sideband, suppressed carrier			
A.4.1 telephone channel with separate frequency modulated signals to control the level of demodulated speech signals (Lincompex)	A3J	J3E	
A.4.2 Analogue facsimile (frequency modulation of an audio frequency sub-carrier which modulates the main carrier in the single-sideband suppressed-carrier mode)	A4J	J3C	
A.5 Vestigial sideband			
A.5.1 sound channel of broadcasting quality	A3C	C3E	
A.5.2 monochrome television (video)	A5C	C3F	
A.5.3 colour television	A5C	C3F	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
B. Emission angle-modulated			
B.1 Frequency modulation			
B.1.1 sound channel of broadcasting quality	F3	F3E	
B.1.2 telephone channel with privacy device	F3	F3E	
B.1.3 analogue facsimile	F4	F3C	
B.1.4 Colour television (video)	F5	F3F	
C. Emission of pulses			
C.1 A sequence of pulses, modulated			
C.1.1 in amplitude			
C.1.1.1 telephone channel without privacy device	P3D	K3E	
C.1.2 in phase or position			
C.1.2.1 analogue data transmission	P1F	M3D	
C.1.2.2 analogue telecommand	P1F	M3D	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
V. Two or more channels containing quantized information operating simultaneously or in a pre-established sequence, all of which modulate the sub-carriers in frequency or phase			
A. Emission predominantly amplitude-modulated			
A.1 Double-sideband			
A.1.1 multichannel voice-frequency telegraphy with error-correction	A7	AAB	
A.2 Single-sideband, reduced carrier			
A.2.1 multichannel voice-frequency telegraphy with error-correction in which some channels are time-division multiplexed	A7A	RAB	
A.3 Independent sidebands			
A.3.1 quantized facsimile in one sideband and multichannel voice-frequency telegraphy with error-correction and time-division multiplex in the other sideband	A9B	BAG	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
VI. Two or more channels containing quantized information operating simultaneously or in a pre-established sequence			
A. Emission predominantly amplitude-modulated			
A.1 Double-sideband (with two or more audio-frequency sub-carriers)			
A.1.1 standard frequency emission	A2	AEL	
B. Emission angle-modulated			
B.1 Frequency modulation			
B.1.1 Four-frequency diplex	F6	FEB	
B.2 Phase modulation			
B.2.1 Digital radio-relay system, in which the baseband is constituted by pulse-code modulated telephony channels in time-division multiplex and modulates the main carrier in quadrature phase-shift keying	F3	GFE	

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
VII. Two or more channels containing analogue information operating simultaneously or in a pre-established sequence *			
A. Emission predominantly amplitude-modulated			
A.1 Single-sideband, full carrier			
A.1.1 several telephone channels in frequency-division multiplex	A3H	BJE	
A.2 Single-sideband, reduced-carrier			
A.2.1 sound channels of broadcasting quality	A3A	BJE	
A.3 Single-sideband, suppressed-carrier			
A.3.1 telephone channels of good commercial quality with privacy device	A3J	JJE	
A.4 Independent sidebands			
A.4.1 sound channels of broadcasting quality	A3B	BJE	
A.4.2 telephone channels of good commercial quality with privacy device	A3B	BJE	
A.4.3 two analogue facsimile signals using frequency modulation of sub-carriers	A4B	BJC	
A.4.4 telephone channels, each with separate frequency-modulated signals to control the level of demodulated speech signal (Lincompex)	A3B	BJE	

* In the present set of examples, there are no examples of two or more channels containing analogue information in a pre-established sequence.

Description	RR Art. 2 Symbol	Symbols proposed in this method	
		§§ 5, 6, 7	
B. Emission, angle-modulated			
B.1 Frequency modulation			
B.1.1 stereophonic sound channel of broadcasting quality	F3	FJE	
B.1.2 telephone channels of good commercial quality	F3	FJE	
B.1.3 FDM-FM radio-relay system, multi-channel telephony in which the base-band is constituted by frequency-division multiplex and modulates the main carrier in frequency	F3	FJE	
B.1.4 colour television with four sound channels of broadcasting quality	F9	FJK	

Description	RR Art. 2 Symbol	Symbols proposed in this method §§ 5, 6, 7	
VIII. Composite systems, transmitting simultaneously or in a pre-established sequence one or more channels containing quantized information together with one or more channels containing analogue information			
A. Emission predominantly amplitude-modulated			
A.1. Double-sideband			
A.1.1 telegraphy using code with elements of differing numbers and/or durations for automatic reception (on one sub-carrier) together with one telephone channel (on a second sub-carrier)	A9	APH	
A.1.2 VOR with voice consisting of the main carrier modulated by:			
- a 30 Hz sub-carrier,			
- a carrier resulting from a 9960 Hz tone frequency-modulated by a 30 Hz tone,			
- a telephone channel,			
- a 1020 Hz keyed tone for continual Morse identification	A9	AFL	

Description	RR Art. 2 Symbol	Symbols proposed in this method §§ 5, 6, 7	
A.2 Independent sideband			
A.2.1 several telegraph channels using code with elements of the same number and duration with error-correction together with several telephone channels with privacy devices	A9B	BPH	
B. Emission, angle-modulated			
B.1 Frequency modulation			
B.1.1 several telegraph channels using code with elements of the same number and duration without error-correction (frequency-shift keying) together with several telephone channels	F9	FPH	

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